THE UNIVERSITY OF ARIZONA
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Cotton Root Rot

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Introduction

Cotton root rot is a serious soilborne fungal disease of cotton and numerous dicot plants in the south-western United States and northern Mexico. The disease is also known as Texas root rot, Phymatotrichopsis or Phymatotrichum root rot, and Ozonium root rot. Ozonium root rot was first described in cotton in Texas in the late 1800s and is now geographically confined in a region that stretches from eastern Texas and southern Oklahoma west through Arizona and south into Mexico (Lyda, 1978). In the US, cotton root rot is an economically important disease that causes approximately $ 100 million in annual losses to the cotton crop and severe economic losses to alfalfa, fruit and nut orchards and grapes. In Arizona, cotton root rot is found across the southern portion of the state. Highly prone areas include the flood plains and certain tributaries of the Gila, Santa Cruz, San Pedro, Colorado and Salt Rivers. The average loss of raw cotton fiber yield is estimated at 2.2 %, with losses of 8-13% in heavily infested fields. Cotton root rot is a major limitation to cotton production in Arizona and is often difficult to manage, even with conventional strategies and fungicide flutriafol (Topguard Terra).

Wilting and plant death caused by cotton root rot fungus at disease onset in early July

Fast expanding disease foci (note: healthy survivor plants surrounding dead plants that were escaped from leading infection edge)

Pathogens

Phymatotrichopsis omnivora (abbreviated as PO) is a soil-inhabiting fungus but a poor saprophyte. It thrives in the low-organic matter soils and calcareous clay soils with a pH range of 7.0 – 8.5 (Lyda, 1978).

Host Range:

PO has a wide host range and can attack more than 2,300 dicotyledonous plants, including many ornamental and important agronomic crops. The fungus can colonize but often does not kill monocotyledonous plants (grasses and palm), which are highly tolerant or resistant to PO.

Symptoms and Diagnosis:

All cotton varieties are highly susceptible, with Pima cotton more severely affected due to its longer growing season and exposure. Disease onset often starts in early July. Rapid wilt and death of PO-infected plant often first appears on blooming plants in mid-summer or fall, especially when bolls are formed and there are adequate soil moisture or after 1-inch rainfall during monsoon season. Leaves will turn yellow or brown quickly and remain firmly attached to the wilting plant. Leaf drop may occur. The tap root of affected plants is destroyed and often pulled out of ground with little efforts. Rotted root bark are readily sloughed off. The root surface just below soil line can be covered with white to light brown strands or

hyphal webs of the fungus. Field signs begin with one or more spots of dying or dead plants. This spot rapidly expand outward under favorable disease development conditions. Each individual spot is mostly circular, unless adjacent spots grow to coalesce. Some plants in the center of spot behind leading edge of infection may survive with altered root architecture. Spore mats may be visible on the soil surface of leading infection edge after rainfall. Spore mats (2 to 16 inches in diameter) are first snow-white and cottony, then later turn tan and powdery.

Conditions can be confused with:

Verticillium wilt. Verticillium wilt causes vascular staining (flecking) in the stem and may defoliate plant. Verticillium-affected plants often scatter randomly in the field. If you have any questions regarding this and other cotton diseases, contact your local extension office or Randy Norton (e-mail:rnorton@arizona.edu; phone: 928-651-0420) or Alex Hu (e-mail:epp@arizona.edu; phone:863-594-0505).

Disease Cycle:

PO survives indefinitely in soils as sclerotia that can occur up to 7 feet deep in soil. Sclerotia are resting bodies about the size of a pinhead (1-2 mm in diameter), initially light tan in color but later dark and warty. They germinate and produce hyphae that form mycelial strands growing through the soil. Initial infection occurs as the hyphae enter the root. The fungus colonizes the root and stem immediately below the soil line. It rapidly destroys the root systems and disrupts water and nutrient uptake from soil. Mycelial strands formed on infected plant can grow through soil to infect adjacent plants. Once a plant is killed, a large number of sclerotia are produced and returned to soil. The disease often re-occurs in the same spot if cotton is continuously cropped. The disease development is favored by warm soil temperature (60 to 95 °F), high soil moisture, and rainfall.

Management

Historically, management of cotton root rot has been difficult (Lyda, 1978; Rush and Lyda, 1982). For example, injection of methyl bromide/chloropicrin into pre-irrigated cotton beds at 18-inch depths has given good control of the disease in Marana and Safford, but this practice is costly and the protection is temporary (Streets, 1937). There are no resistant varieties available and most of conventional strategies were either ineffective or impractical. However, since its introduction to cotton industry in 2015, flutriafol (Topguard Terra, FMC) has become an important tool for managing the disease. Topguard Terra fungicide can be applied to cotton fields at planting via T-band, modified in-furrow and drip irrigation. Watering via irrigation or rainfall within 3 weeks of planting is needed for good efficacy. However, delayed or reduced emergence resulting from phytotoxicity problem may occur if there was heavy rainfall prior to seed emergence. New product formulation and application methods are being evaluated to improve efficacy while avoiding phytotoxicity problem. Other management approaches with limited success include: 1) improve soil health and microbial diversity by increasing organic matter in soil. Targeted treatment of infested areas with up to 20 tons/acre of manure has been used successfully in some locations in Arizona (Streets, 1937); 2) summer rotations with non-host, such as corn or sorghum, immune grasses such as Sudan grass, have reduced disease impact. Double cropping systems (barley, wheat followed by late cotton) also have reduced the disease in Arizona; and 3) deep tillage (6-8 inches) during summer and early fall may reduce sclerotia density at top 8 inches of soil.

Downward wilting of a cotton plant infected with cotton root rot fungus

Defoliation caused by cotton root rot

Wilting plant with open bolls caused by cotton root rot fungus (note: no open bolls on adjacent plants, physiological stress by cotton root rot fungus induced boll cracking prematurely)

Spore mat of cotton root rot fungus (Photo credit: Mary W. Olsen)

Root rot with decayed outer bark layer sloughed off readily

Growth of cotton root rot fungus on root and base of stem

Sclerotia formed on the outer surface of rotten bark

Appearance of cotton root rot in a field during mid growing season

Additional Resources

Lyda, S.D. 1978. Ecology of *Phymatotrichum omnivorum*. Annual Review Phytopathology 16:193-209

Streets, R. B. 1937. Phymatotrichum (Cotton or Texas) Root Rot in Arizona. College of Agriculture, University of Arizona (Tucson, AZ). Technical Bulletin (University of Arizona, Agricultural Experiment Station) No. 71

Rush, C.M. and Lyda, S.D. 1982. Effects of anhydrous ammonia on mycelium and sclerotia of *Phymatotrichum omnivorum*. Phytopathology 72:1085-1089

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